Space Weather Technical Forecast

Issued on Saturday, 26 August 2023 at 13:24 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated M-flares throughout (R1-R2 Blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with a peak flare of C5.0 at 25/1549 UTC from AR3405 in the far northwest. There are six sunspot regions on the disc. AR3415 (Dac/Beta-Delta) in the southeast remains the most complex group, with a persistent delta spot, but has remained largely inactive despite this. The region has shown some signs of weakening with reducing penumbral extent and breaking of its trailer umbra. AR3413 (Dho/Beta) is the largest region and is approaching the north-centre disc. It contains a large, rather symmetric positive leader spot and a much smaller negative polarity trailer. There remains some potential instability, given an east-west parity separation line and was responsible for a long-period C2.2 flare at 26/1006 UTC. The other regions are all small and simple unipolar spots, although AR3405 (Hsx/alpha) now approaching the west limb, has shown some low-level activity in recent days.

The LDE C2.2 flare from AR3413 resulted in a coronal dimming that may be evidence for a CME. However, at this time insufficient coronagraph imagery is available to determine if a CME has occurred and if so its precise trajectory.

Solar Wind / Geomagnetic Activity: A largely background solar wind environment was observed as the HSS from CH39/+ eased, with slow ambient to slightly elevated speeds and a peak of 432km/s at 26/0908 UTC. Speeds, observed by ACE at L1 were around 370-400km/s at the end of the period. Density was below average throughout. The interplanetary magnetic field (IMF) Bt, was largely Weak, but increased from 26/0110 UTC to briefly become Moderate at times, with a peak of 8nT at 26/0345 UTC. The north-south component has been mainly negative (southward) with only brief periods of positive (northward) direction, varying between +4/-7nT. Phi angle was predominantly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux remained at Background. GOES16 high energy (greater than 2MeV) electron flux was mostly at Background, rising briefly to peak Moderate with 191 pfu at 25/1935 UTC. The associated 24-hour fluence was well below Active, with 3.41e6 integrated pfu observed at 26/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar Activity is expected to be generally Low, but with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: A low-level LDE C-class flare from AR3413 on 26 Aug may have resulted in an Earth-directed CME, however, insufficient coronagraph imagery is currently available to determine if a CME has occurred and if so its precise trajectory. Otherwise there are no Earth-directed CMEs in the forecast. The next forecast solar wind enhancement will be the arrival of the fast wind of equatorial CH38/- or northern disc CH37/-, either late day 1 or day 2 (26-27 Aug). These winds then easing day 3 (28 Aug) onward. Geomagnetic activity is forecast to be mainly Quiet at first, but rising to Unsettled with a chance of Active intervals from

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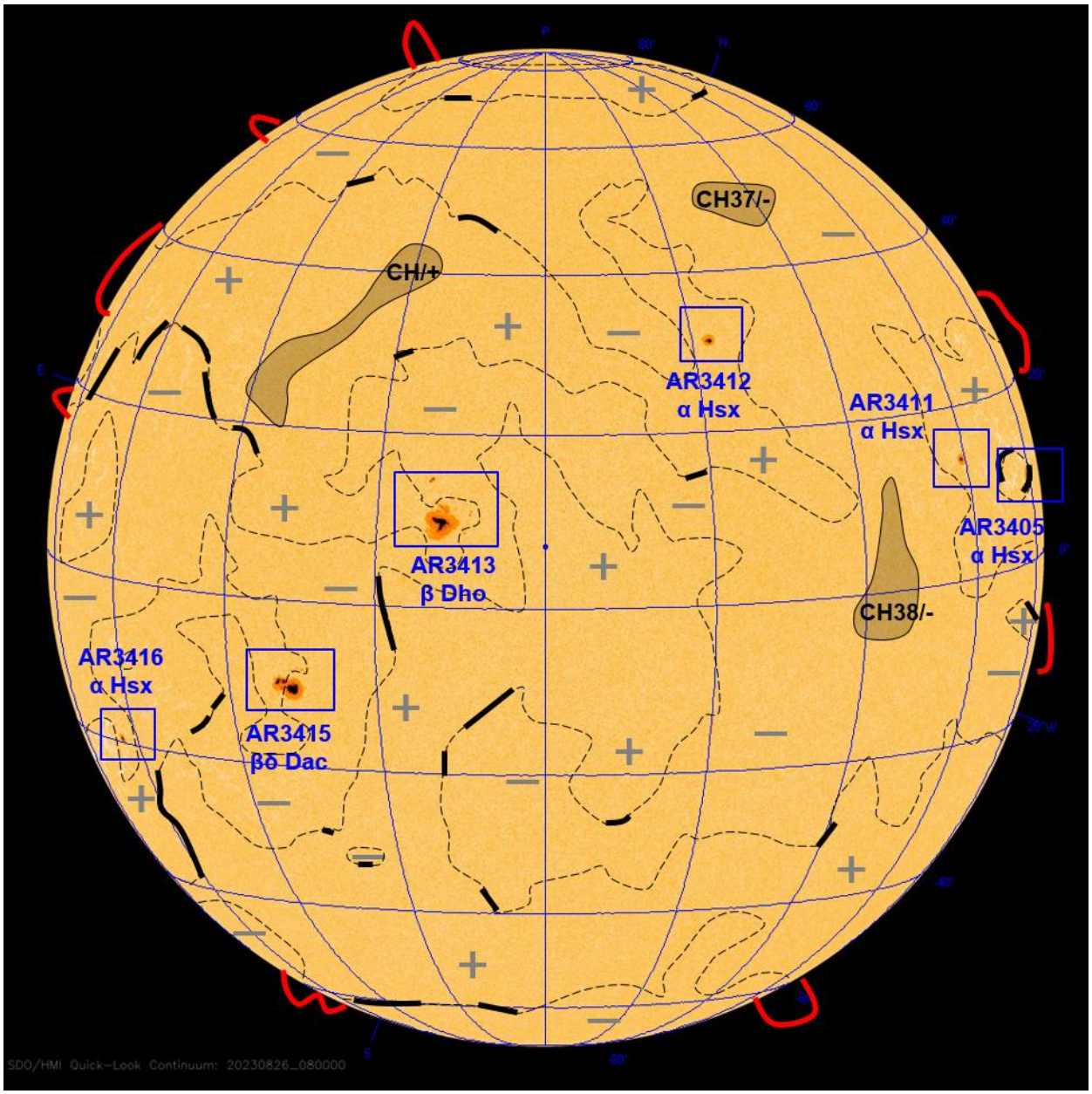
the fast wind enhancement later day 1 or day 2. Activity then easing to be Quiet with Unsettled intervals later in the period.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at Background. High energy (greater than 2 MeV) electron flux has not responded to the recent fast wind, and is now expected to persist at mainly Background until any subsequent enhancement from CH37/38 eased either later day 2 or day 3 (27-28 Aug). Flux is then likely to rise, perhaps to Moderate, with a slight chance of rising to High (1000 pfu) by the end of the period. The associated 24 hour fluence is expected to remain below the Active level (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 26/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The LDE C2.2 flare from AR3413 at 26/1009 UTC resulted in a coronal dimming that may be evidence for a CME. However, at this time insufficient coronagraph imagery is available to determine if a CME has occurred and if so its precise trajectory. Otherwise there are no Earth directed CMEs in the forecast.

Slow winds are expected to prevail at first, with background to slightly elevated speeds, before the arrival of the next fast wind, likely from equatorial CH38/-, but perhaps CH37/- on the northern disc. Onset is currently forecast for either late day 1 (26 Aug), or more likely day 2 (27 Aug), based upon the longitudinal position and an expected peak speed of around 450-500km/s. While MOSWOC Enlil continues to have a poor representation of recent conditions, which reduces confidence in the model forecast, this also suggests an enhancement around a similar time. Any connection to this hole is likely to be relatively subdued due to its negative polarity and the Russel-Mcpherron effect.

Geomagnetic activity is forecast to be mainly Quiet at first, increasing to Unsettled with a chance of Active intervals with the HSS arrival, perhaps late day 1 but most likely day 2 (26-27 Aug). This easing again to Quiet with Unsettled intervals day 3-4 (28-29 Aug).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections - Nil

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Radio Blackouts - X-Ray Flares:

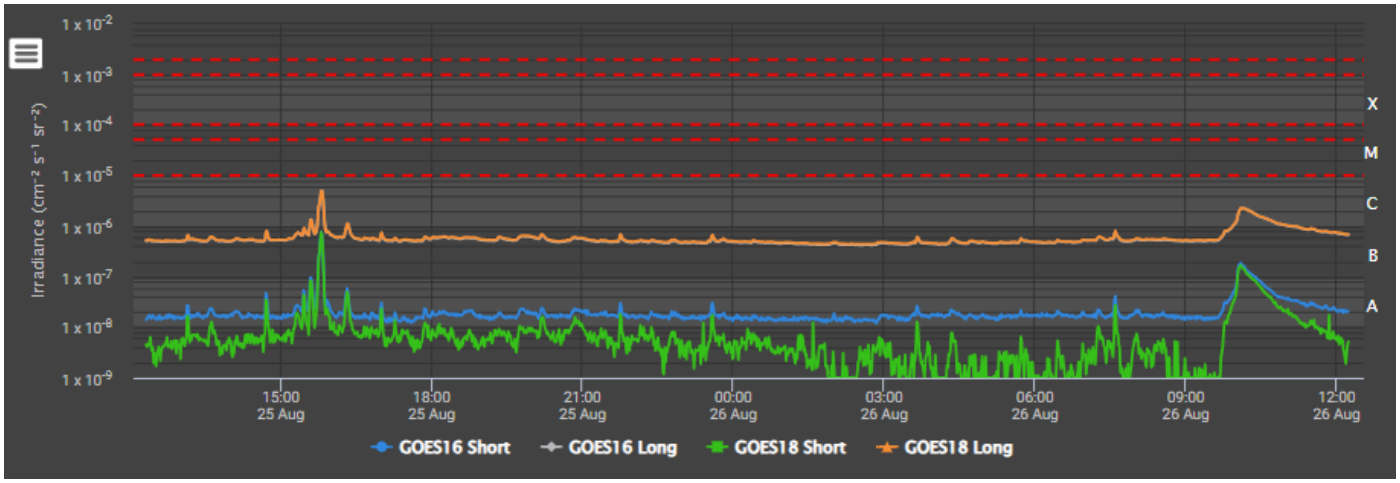
Low activity is expected to continue, but with a chance of rising to Moderate due to a risk of isolated M-flares throughout. A very isolated X-flare cannot be completely ruled out.

There are six sunspot regions on the disc. The majority are small and mature, however there are three of some interest. AR3415 (Dac/Beta-Delta) in the southeast is the most complex, with a reasonably strong delta spot, but aside from the M1.4 flare on 25 Aug, it has been largely inactive. This spot is also showing some mixed development with reducing penumbral extent and breaking of its trailer umbra but also the proliferation of a few small pore like spots on its periphery. The largest spot on the disc, AR3413 (Dho/Beta), is now approaching the north-central disc. This has seen its sizeable leader spot become more symmetric in appearance in recent hours again, with peripheral spots generally fading, as has the small trailer spot in the north. Although it has been largely inactive it was responsible for a LDE C2.2 flare at 26/1006 UTC.

Out of the mature and unipolar spots AR3405 is the largest and has shown some low level activity, however this appears to be simplifying as it approaches the northwest limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 2: GOES-16/18 X-ray flux. LDE C2.2 flare at 26/1006 UTC was from AR3413.



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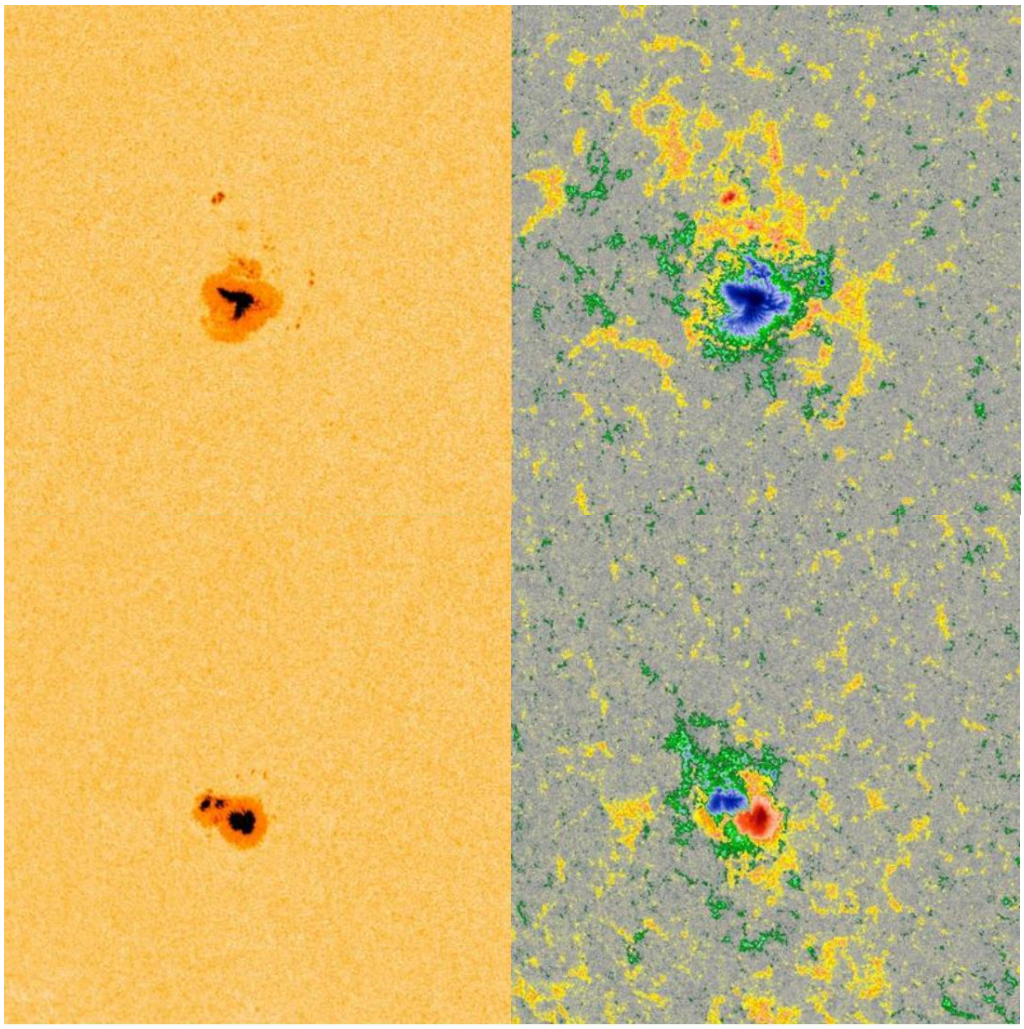
Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux observed by GOES16 is expected to remain at Background. The main risk of any increased proton flux would be from the occurrence of any larger flares of AR3415, currently in the eastern hemisphere.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	2	2	2	2
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 3: SDO Intensitygram (left) and Magentogram (right) of AR3413 (top) and AR3415 (below)



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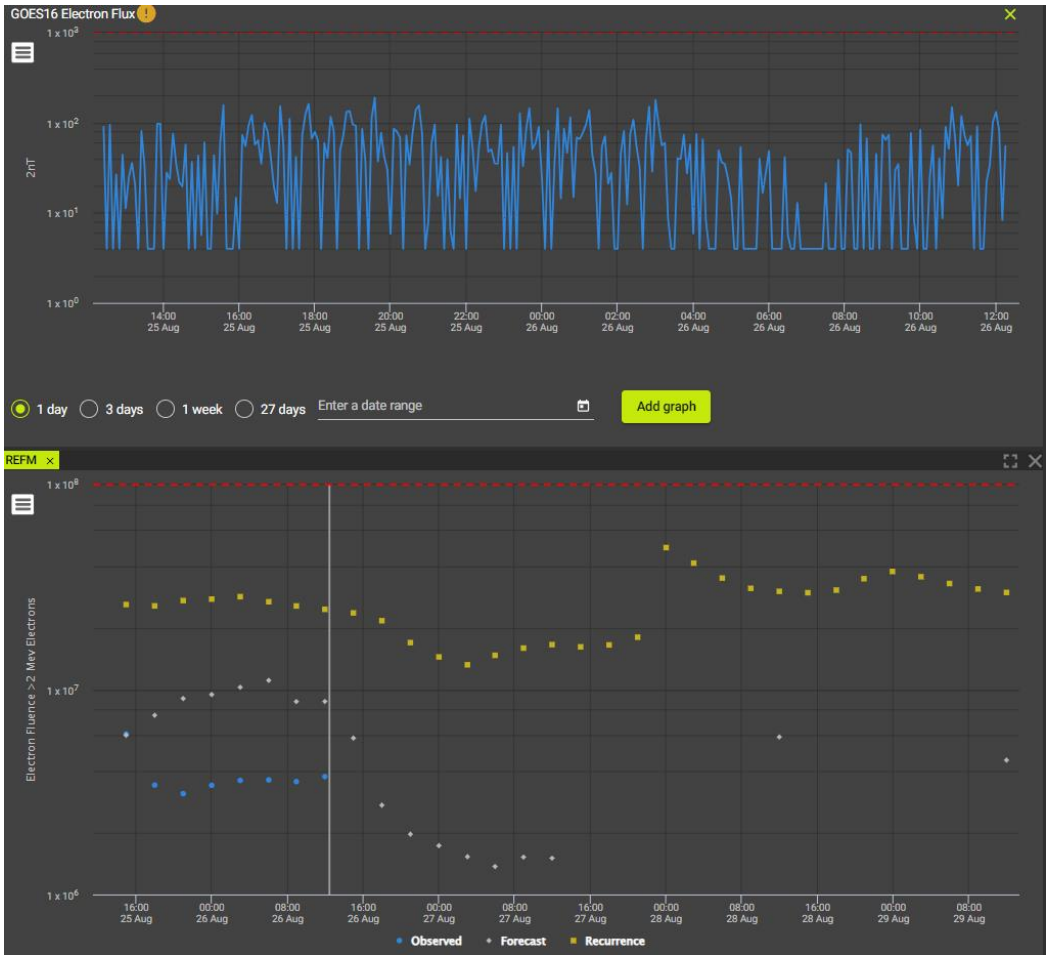
High Energy Electrons Event (≥ 2MeV):
High energy (greater than 2 MeV) electron flux observed by GOES16 persisted at mainly background levels, with only a subdued response to the recent high speed stream. A further fast wind arrival either late day 1 or more likely day 2 (26-27 Aug) may bring a further enhancement. However, given the limited geomagnetic response anticipated, any increase to the observed flux is again likely to be rather limited, peaking at Moderate with only a slight chance of reaching High at diurnal maximum

The associated 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) level, but rising later the period in response to this enhancement. Below Active fluence is currently supported by REFM.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: GOES-16 >2MeV Electron Flux (top) and Fluence with REFM and Recurrence (below)



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